Chapter 2 Outline

Elements — make up all matter

* Ninety-two naturally occurring (Table 2-1)
* Twenty additional, created in the laboratory
* Identified by name or chemical symbol
* Also identified by number based on structure of atoms

Atoms — subunits of elements; smallest complete units of matter; cannot be broken down or changed by ordinary means

Nucleus at the center, contains:

Protons — positively charged electrical particles

Atomic number — number of protons present in nucleus of each of element’s atoms

Neutrons — neutrally charged

Electrons in orbit outside nucleus

Negatively charged

Determine how atom will react chemically

Equal in number to protons in nucleus

Energy levels — regions in which electrons orbit nucleus, at specific distances from nucleus

Different energy levels hold different numbers of electrons

Closer to nucleus hold fewer electrons

Farthest electrons give atom its characteristics (positive or negative charge)

* Molecules
* When two or more atoms unite on basis of their electron structures
* Sometimes like atoms, more often not
* Smallest subunits of a compound
* Compounds
* Substances composed of two or more different elements
* Molecule smallest subunit of a compound
* Each molecule in a compound contains elements that make up that compound in the proper ratio
* Water a compound: H2O
* Water of critical importance in all physiologic processes in body tissues; most abundant compound in the body
* Carries substances to and from the cells
  + - Possible because it is a universal solvent
* Stable, provides constant environment for body cells
* Distributes heat through body and cools body through evaporation
* Makes essential processes possible:
  + - Absorption
    - Exchange
    - Secretion
    - Excretion
    - Part of many of body’s chemical reactions, e.g., needed directly in digestion and many metabolic reactions in cells.
* Mixtures — blends of two or more substances
* Three types (Table 2-2)
* Solution — homogeneous, formed when one substance dissolves in another
  + - Table Salt (NaCl) dissolved in water
    - Table sugar (sucrose) dissolved in water
* Suspension — heterogeneous mixture, one substance dispersed in another; will settle if not constantly mixed
  + - Red blood cells in blood plasma
    - Milk of magnesia
* Colloid — heterogeneous mixture, suspended material does not dissolve, remains evenly distributed based on the small size and opposing charges of the particles
  + - Proteins in blood plasma
    - Cytosol
* Ionic bonding (Fig. 2-3)
* Type of bond formed when electrons are transferred from one atom to another
* Ion — atom or group of atoms with + or - charge
  + - Net + charge (more protons than electrons) = cation
    - Net - charge (more electrons than protons) = anion
* Electrolytes (see Learning Outcome 2-7)
* Covalent bonding (Fig. 2-4)
* Sharing of electrons between the atoms in the molecule
* More frequent type of bond than ionic.
* May involve the sharing of one, two, or three pairs of electrons between atoms
* Nonpolar covalent bond — no part of the molecule is more + or - than any other part

Carbon, basis or organic chemistry, forms covalent bonds with wide variety of elements

* Electrolytes
* Compounds formed by ionic bonds release ions when they are in solution, called electrolytes
* In practice, also used to refer to the ions themselves in body fluids
* Include variety of salts, also acids and bases
* Important be in right amount in intra- and extracellular fluid; affect homeostasis
* Conduct electricity
* Acid
* Chemical substance capable of donating a hydrogen ion to another substance
* Base
* Chemical substance that can accept a hydrogen ion
* Usually contains a hydroxide ion
* Also called an alkali
* Salt
* Produced by a reaction between an acid and a base
* pH units represent the relative concentration of hydrogen (acid) and hydroxide (base) ions in a solution; as one increases, the other drops
* Scale of pH units from 0 to 14 (Fig. 2-5)
* Based on multiples of 10; each pH unit represents a 10-fold change
* 0 is most acidic, 14 is most basic
* A pH of 7.0 is neutral
* Blood and other body fluids are close to neutral but slightly on alkaline side
* Buffer
* For health, body fluids must stay within narrow limits of acidity and alkalinity; delicate balance
* Buffers chemicals that maintain stability in the pH of body fluids
* Radioactivity
* Isotopes which disintegrate and give off atomic particles are radioactive
* Uses in medicine
* Treatment of cancer
  + - Particles destroy tumors
* Diagnosis
  + - X-rays penetrate tissues and produce an image of their interior
* Organic compounds
* Chemical compounds that characterize living things
* All contain the element carbon
* Most are large, complex molecules
* Main types — all contain carbon, hydrogen, and oxygen:
  + - Carbohydrates
    - Lipids
    - Proteins
* Carbohydrates (Fig. 2-7)
* Basic units are monosaccharides
* Lipids (Fig. 2-8)
* Defined by insolubility in water rather than components (different lipids made from different building blocks)
* Proteins (Fig 2-9)
* Amino acids Enzyme
* Proteins essential for metabolism
* Serve as catalysts in hundreds of reactions within cells
* Each enzyme works only on a specific substance (substrate) and does only one specific chemical job
* Needed in very small amounts
* Lock-and-key mechanism (Fig. 2-10)
  + - Enzyme’s form must match the shape of the substrate
* Molecules and compounds: *dehydration, hydrophilic, hydrophobic, homogeneous, heterogeneous, aqueous*
* *hydr/o* (water)
* *phil* (to like)
* -*phobia* (fear)
* *hom/o* (same)
* *heter/o*- (different)
* *aqu/e* (water)
* Chemical bonds: *covalent*
* *co*- (together)
* Chemistry of living matter: *monosaccharide, disaccharide, polysaccharide, glycogen, triglycerides*
* *sacchar/o* (sugar)
* *mon/o-* (one)
* *di-* (two, double)
* *poly*- (many)
* *glyc/o* (sugar, glucose, sweet)
* *tri*- (three)
* *de*- (remove)

-*ase* (used to name enzymes)